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Optical Frequency Comb Generation in Silicon-Carbide Microdisk Resonators

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14. ABSTRACT

The PI's group has carried out detailed investigation on the conditions for fabricating high-quality silicon carbide microdisk resonators for frequency comb application. An optical Q of about 6200 was obtained for the first generation devices. This result was published in a paper (Xiyuan Lu et al, Opt. Lett. v38, 1304 (2013)). The detailed testing scheme and fabrication details can be found in the paper. The optical Q was recently improved to 2*10^4 and a paper is under preparation for submission. The PI's group has also investigated innovative schemes for precise dispersion engineering of microresonators. These schemes were successfully applied in silicon microdisk resonators which produced frequency comb at single photon level, the unique photon-pair comb, with extremely high quality: a spectral brightness of 6.24*10^7 pair/s/mW^2/GHz, and a coincidence-to-accidental ratio of 1386 +/- 278. A paper was submitted for publication for this result (Wei C. Jiang, et al, arXiv: 1210.4455v1 (2012)). The testing scheme, device performance, device fabrication details, and related theoretical modeling can all be found in the paper.

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Accomplishments: The PI's group has carried out detailed investigation on the conditions for fabricating high-quality silicon carbide microdisk resonators for frequency comb application. An optical Q of about 6200 was obtained for the first generation devices. The thermal-optical properties were characterized for the device. These results were published in a paper (Xiyuan Lu et al, Opt. Lett. v38, 1304 (2013)). The detailed testing scheme and fabrication details can be found in the paper. With further optimizing the fabrication procedure, the optical Q was recently improved to 2×10^4, the highest Q among all SiC photonic devices reported to date. A significant Kerr nonlinearity was observed in the device. A dramatically fast response of thermal fluctuations was also observed. A paper about these new results is under preparation for submission. The PI's group has also investigated innovative schemes for precise dispersion engineering of microresonators. These schemes were successfully applied in silicon microdisk resonators which produced frequency comb at single-photon level, the unique photon-pair comb, with extremely high quality: a spectral brightness of 6.24×10^7pair/s/mW^2/GHz, the highest value reported to date, and a coincidence-to-accidental ratio of 1386 ±278. Similar performance was observed to maintain among all photon-pair combs. A paper was submitted for publication for this result (Wei C. Jiang, et al, arXiv: 1210.4455v1 (2012)). The testing scheme, device performance, device fabrication details, and related theoretical modeling can all be found in the paper.

Archival publications:

1. X. Lu, J. Y. Lee, Philip X.-L. Feng, and Q. Lin, "Silicon carbide microdisk resoantor", Opt. Lett. **38**, 1304 (2013).
2. W. C. Jiang, X. Lu, J. Zhang, O. Painter, and Q. Lin, "A silicon-chip source of bright photon-pair comb", arXiv: 1210.4455v1 (2012).